also have been unable to detect decided colour with any telescope, beyond a ruddy tinge in one or two, certainly no colour to compare even remotely with those of κ Crucis. And the magnitudes and positions of the stars around η, as seen in the Great Telescope, agree in most cases sufficiently well to enable the discrepancies to be assigned to ordinary errors of observation and reduction. Where any important differences occur they are generally found among small stars, which, although palpable enough in a four feet aperture, must have been at the extreme limit of vision in Sir John's 18-inch reflector.

It does not seem to have been before remarked of the stars which are in optical connection with the nebula, that they cluster most about those parts where the nebula is, or has been, most condensed. This appears from Sir John Herschel's drawing and catalogue as well as my own, and is suggestive of physical connection between stars and nebula.

Art. XXXIII.—*Areometer.* By George Foord, Esq.

[Read 9th October, 1871.]

The instrument which I have now the pleasure of submitting to your inspection involves no new principle, and can scarcely lay claim to novelty of form; it is in fact no more than a modification or expansion of what has been already described. I beg to remind you that occasionally during the Society's meetings, when the papers read have happened to make a somewhat short evening's sitting, it has been felt that some light supplementary subject would fulfil a want, by extending the business to a convenient duration. It is in this sense that I now venture to place this form of areometer before you, premising that in Lehmann's Physiological Chemistry,—the English edition, published by the Cavendish Society, at page 437 of vol. ii. of that work, occurs the following passage:—"Among the different areometers there is only one which deserves any special notice; but this instrument, which is constructed by Alexander, of Munich*, yields, according to my experience, much more accurate results than one might be disposed to expect, *a priori*, from its construction. It is arranged in the following manner: — 'two parallel graduated tubes,

* Polytechn. Centralb., 1847, Heft 6, s. 361.

both open at one end and communicating with each other at their other ends, at which is a small syringe, are introduced, the one into water, the other into the liquid to be examined. The air in the tubes is now slightly rarified by means of the syringe, when, by comparing the elevation of the water and of the other liquid in the tubes, the ratio of their specific gravities is given. This is the best of all the instruments for rapidly determining the density, as the influence of temperature and of atmospheric pressure are here almost eliminated."

The instrument before you conforms in principle and in general arrangements with the description quoted. We have, you will observe, two glass tubes, each about three feet long and of very nearly the same internal diameter, namely, three-quarters of an inch. The lower ends of these tubes are open; the upper ends, also open, are contracted, and fashioned for juncture with caoutchouc tubular couplings. Two wooden rods, each four feet long, are fixed on a stout wooden base, so as to occupy a vertical position with an intervening space of twelve inches between them, and near their tops a light cross piece of wood connects these rods and preserves their parallel position. On the top cross-piece is fixed, in cork mountings, a tubular ⊥ shaped glass connecting piece, to each of the two lower openings of which is appended by a caoutchouc junction one of the before-mentioned vertical glass tubes; and to the upper opening of this glass junction piece is in the same manner connected a pewter tube, which arches over, is carried down one of the vertical wooden rods, and at its lower extremity, which is again curved upwards, is affixed a caoutchouc syringe—that is to say—a bulb of india-rubber with valves, and which will pump air when alternately compressed by hand pressure and allowed to expand.

Two matched ordinary glass beakers are placed under the pendant three feet glass tubes, and are blocked up to a proper height by wooden blocks, so that the lower opening of each glass tube is half an inch or less above the bottom of its beaker. A screw-clip is attached to the caoutchouc coupling over the branched glass tube at the top of the two vertical measuring tubes, and this completes the arrangement.

If mercury be poured into one of the beakers and distilled water into the other, so as to seal off the air contained in the two vertical tubes from direct contact with

the exterior atmosphere, and if a few strokes of the syringe be now effected, a portion of air will be pumped out of the tubes, and in consequence the fluids—the mercury and the water—will rise in their respective tubes. The heights of the columns thus raised will be inversely as the specific gravities of the liquids; thus, in round numbers, with mercury having a specific gravity of thirteen and six-tenths, for one inch of column of mercury, we shall have a column of distilled water measuring thirteen and six-tenths inches, or for any given height of mercury that of distilled water will be thirteen and six-tenths times as great; always measuring from the surface of the fluid in the beaker to the top of the column standing in the tube. The measurements are made with the cathetometer, by the vernier of which the five-hundredth part of an inch is measurable, and when the utmost attainable accuracy is required, the mean of several measurements may be taken. Results are thus obtained with great rapidity, and the arrangement appears to promise some special advantages in comparing the specific gravities of fluids through a range of varying temperatures, as well as in the case of fluids of more or less viscous character, such, for instance, as blood and other animal fluids. One point of interest in reference to this mode of taking specific gravities is the fact that the measures are in a certain sense absolute, for although mere linear measurement, as an indication of mass, will not compare with the decisions of the balance; yet, on the other hand, we have no corrections to make for the altered capacity of the containing vessel following change of temperature, as in taking the specific gravity of fluids in the balance by means of the ordinary specific gravity bottle.

It is true that capillary action is an influence to be taken into account in interpreting results obtained with this areometer; and it is also true that with certain fluids, as with oil-of-vitriol and water for example, the one will in time distil over, even at ordinary temperatures, and will sooner or later vitiate the fluid with which it is compared,—the water will thus distil over and dilute the oil-of-vitriol; but these are not disturbing causes of such a character as to forbid the readily obtaining reliable and valuable results by employment of this instrument. As a means of demonstrating, from the lecture table, the relative specific gravities of different fluids, this arrangement certainly possesses very notable advantages.